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Hiring motivated workers: optimal contract lengths and wage schemes

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Abstract

This paper examines the optimal contract length and wage scheme for effectively hiring intrinsically motivated workers. A important key aspect of this study is that intrinsic motivation is treated as an experience good, where the worker learns about their motivation by working for the employer. An intertemporal choice model with multiple periods is developed to gain insight into the hiring process. We analyse four cases of contracts: short-term and long-term contracts, each combined with either a fixed or an incentive wage scheme. Our results indicate that offering an incentive wage scheme, as opposed to a fixed wage scheme, increases the employer's incentive to hire new workers for both contract lengths. Additionally, short-term contracts provide a higher incentive to hire new workers compared to long-term contracts, leading to more workers learning their motivation. Furthermore, we demonstrate that only short-term contracts are able to reflect the learned information about worker's motivation. Although, the study has limitations due to assumptions that may not always reflect the real world, these insights could help employers more effectively hire highly motivated workers and improve organizational performance.

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Overview of notation

In this paper, abbreviations are used as notation in the intertemporal choice model of chapter 3, 4 and the comparisons in chapter 5. The following table provides an overview of this notation. The first column will contain the abbreviation. The next column defines the meaning of the abbreviation in the model. Finally, the third column is about the page where the abbreviation is introduced.

Abbreviation	Meaning	Page
U_{Ai}	Utility of a worker of type *i*, working at the employer.	14
w	The wage scheme.	14
γ_i	Intrinsic motivation parameter of a worker type *i.*	14
γ_H	Intrinsic motivation parameter of a high type worker.	14
γ_L	Intrinsic motivation parameter of a low type worker.	14
γ_E	Expected intrinsic motivation parameter of a worker who is unaware of his type.	14
e	Effort level of a worker.	14
$V(e)$	Function of benefits.	14
$C(e)$	Function of costs.	14
U_{out}	The outside option utility for the worker.	14
$V'(e)$	First derivative of benefits function with respect to effort.	15
$C'(e)$	First derivative of cost function with respect to effort.	15
$V''(e)$	Second derivative of benefits function with respect to effort.	15
$C''(e)$	Second derivative of cost function with respect to effort.	15
U_P	Utility of an employer.	15
p	The price.	15
Π	The probability of being a high type worker.	15
α	The fixed wage part of the wage scheme.	15
EU_{AE}	Expected utility of a worker who is unaware of his type when a fixed wage scheme is offered (in an one-period model).	16
e^E	Optimal effort level of a worker who is unaware of his type when a fixed wage scheme is offered.	16
α_{AE}^{min}	The minimum fixed wage that a worker, who is unaware of his type, is willing to accept when a fixed wage scheme is offered.	16
EU_P	Expected utility of the employer who is unaware of the worker's type when a fixed wage scheme is offered (in a one-period model).	16

β	Bonus payment for each unit of effort when an incentive wage scheme is offered.	16
EU_{AiB}	Expected utility of a worker type *i* when an incentive wage scheme is offered (in an one-period model).	16
e^{iB}	Optimal effort level of a worker type *i*, when an incentive wage scheme is offered.	16
EU_{AEB}	Expected utility of a worker who is unaware of his type when an incentive wage scheme is offered (in an one-period model).	17
e^{EB}	Optimal effort level of a worker is unaware of his type when an incentive wage scheme is offered.	17
α_{AEB}^{min}	The minimum fixed wage that a worker, who is unaware of his type, is willing to accept when an incentive wage scheme is offered.	18
EU_{PB}	Expected utility of the employer who is unaware of the worker's type when an incentive wage scheme is offered (in a one-period model).	18
e^{i}	Optimal effort level of a worker type *i,* who knows his type when a fixed wage scheme is offered.	18
e^{H}	Optimal effort level of high type worker, who knows his type when a fixed wage scheme is offered.	18
e^{L}	Optimal effort level of a low type worker, who knows his type when a fixed wage scheme is offered.	18
U_{PH}	Optimal utility of the employer over a period when a high type worker who knows his type is hired and a fixed wage scheme is offered.	18
α_{AH}^{min}	The minimum fixed wage that a high type is willing to accept when a fixed wage scheme is offered.	18
U_{PL}	Optimal utility of the employer over a period when a low type worker who knows his type is hired and a fixed wage scheme is offered.	18
α_{AL}^{min}	The minimum fixed wage that a low type worker is willing to accept when a fixed wage scheme is offered.	18
α_{Ai}^{min}	The minimum fixed wage that the worker type *i* is willing to accept when a fixed wage scheme is offered.	19
$E(\gamma_i)$	Function of optimal effort level determined by intrinsic motivation.	19
$E'(\gamma_i)$	First derivative of the function of optimal effort level with respect to the intrinsic motivation parameter.	19

EU_{2A}	Expected utility of a worker who is unaware of his type in period one when a fixed wage scheme is offered under short-term contracts (in a two-period model).	20
EU_{2P}	Expected utility of an employer who is unaware of the worker's type in period one when a fixed wage scheme is offered under short-term contracts (in a two-period model).	21
U_{AiB}	Utility function of a worker type *i*, when an incentive wage scheme is offered.	21
e^{HB}	Optimal effort level of a high type worker, who knows his type when an incentive wage scheme is offered.	21
e^{LB}	Optimal effort level of a low type worker, who knows his type when an incentive wage scheme is offered.	21
α_{AiB}^{min}	The minimum fixed wage that the worker type *i* is willing to accept when an incentive wage scheme is offered.	21
U_{PHB}	Optimal utility of the employer over a period when a high type worker who knows his type is hired and an incentive wage scheme is offered.	22
α_{AHB}^{min}	The minimum fixed wage that a high type worker is willing to accept when an incentive wage scheme is offered.	22
U_{PLB}	Optimal utility of the employer over a period when a low type worker who knows his type is hired and an incentive wage scheme is offered.	22
α_{ALB}^{min}	The minimum fixed wage that a low type worker is willing to accept when an incentive wage scheme is offered.	22
α_{AEB}^{min}	The minimum fixed wage that the worker, who is unaware of his type, is willing to accept when an incentive wage scheme is offered.	22
EU_{2AB}	Expected utility of a worker who is unaware of his type in period one when an incentive wage scheme is offered under short-term contracts (in a two-period model).	22
EU_{2PB}	Expected utility of an employer who is unaware of worker's type in period one when an incentive wage scheme is offered under short-term contracts (in a two-period model).	23
EU_{NA}	Expected utility of a worker who is unaware of his type in period one when a fixed wage scheme is offered under short-term contracts (in a N+1 period model).	23

EU_{NP}	Expected utility of an employer who is unaware worker's type in period one when a fixed wage scheme is offered under short-term contracts (in a N+1 period model).	23
EU_{NAB}	Expected utility of a worker who is unaware of his type in period one when an incentive wage scheme is offered under short-term contracts (in a N+1 period model).	24
EU_{NPB}	Expected utility of an employer who is unaware of worker's type in period one when an incentive wage scheme is offered under short-term contracts (in a N+1 period model).	24
EU_{NA}^{Long}	Expected utility of a worker who is unaware of his type in period one when a fixed wage scheme is offered under a long-term contract (in a N+1 period model).	25
α^{Long}	Fixed wage when a fixed wage scheme is offered under a long-term contract.	25
α_{Long}^{min}	Minimum fixed wage that the worker is willing to accept when a fixed wage scheme is offered under a long-term contract.	25
U_{PH}^{Long}	Optimal utility of the employer over a period, when a high type of worker who knows his type, is hired when a fixed scheme is offered under a long-term contract.	26
U_{PL}^{Long}	Optimal utility of the employer over a period, when a low type worker who knows his type is hired when a fixed wage scheme is offered under a long-term contract.	26
EU_{NP}^{Long}	Expected utility of an employer who is unaware the worker's type in period one when a fixed wage scheme is offered under a long-term contract (in a N+1 period model).	26
EU_{NAB}^{Long}	Expected utility of a worker who is unaware of his type in period one when an incentive wage scheme is offered under a long-term contract (in a N+1 period model).	27
α^{LongB}	Fixed wage under a long-term contract when an incentive wage scheme is offered.	27
α_{LongB}^{min}	Minimum fixed wage that the worker is willing to accept under a long-term contract when an incentive wage scheme is offered.	27

U_{PBH}^{Long}	Optimal utility of the employer over a period when a high type worker type who knows his type is hired when an incentive wage scheme is offered under a long-term contract.	27
U_{PBL}^{Long}	Optimal utility of the employer over a period when a low type worker type who knows his type is hired when an incentive wage scheme is offered under a long-term contract.	27
U_{NPB}^{Long}	Utility of an employer who is unaware of the worker's type in period one when an incentive wage scheme is offered under a long-term contract (in a N+1 period model).	28

1. Introduction

Employers in all of the European states are facing the problem of labour and skill shortage (Directorate-General for Communication European Commission, 2024). Labour shortage occur when the demand for labour exceeds the supply, while skill shortage is more specific and refer to mismatch between demand for workers with particular skills and the available supply. A recent survey revealed that nearly two-thirds of the employers in small and medium-sized businesses report difficulties in finding workers with the necessary skills for their positions. Effective hiring strategies are therefore crucial to implement for the employer.

Labour productivity, as measured by GDP per labour hour, can exhibit significant variation between countries (International Labour Organization, 2024). Labour represents an important production factor in a country's economy, particularly in highly developed countries where it accounts for approximately 70 percent of total production costs (OECD, 2021). Hence, for many organizations, labour stands as a critical determinant of their survival and success. Organizations strive for hiring highly productive workers at a low costs.

According to a report by Pendell (2023), disengaged employees cost the global economy approximately 9% of the GDP. Engaged employees are not only more productive but also contribute to lower turnover rates, higher levels of innovation and increase customer satisfaction. This research indicates that highly engaged workforces outperform their competitors by 147% earnings per share and are more resilient to shocks. Employee engagement is more than working hard at the organization. It is about the intrinsic motivation to exert effort for the organization because you feel engaged. Financial incentives can improve productivity at the organization but can be easily copied by competitors at any time. This is not the case for intrinsic motivation, which can therefore be considered a strategic advantage for the organization.

Effective hiring practices that focus on intrinsically motivated workers are essential for building an engaged workforce and can improve success at the organization. However, identifying intrinsically motivated workers can be challenging. The employer has more knowledge of the job characteristics. On the other hand, the worker has private information about his ability and motivation. One of the obstacles in the decision of the worker can be that his motivation depends on the job characteristics (Johnson, 1978). Hence, the hiring process is a complex decision making procedure with a lot of

uncertainty. Workers are unaware of their job preferences for new positions due to these hidden job characteristics. They need to try-out the job to learn their motivation.

The goal of the paper is to get more insights about the process of hiring motivated workers under different contracts. An intemporal choice model with intrinsic motivation as an experience good will be examined. This paper examines four cases of contracts, combining two different contract lengths with two different wage schemes. The contract length refers to either a short-term or a long-term contract. The wage scheme offered by the employer can consist of either a fixed wage alone or a wage that includes a bonus payment. The research question of this study is:

Under which contract length and wage scheme can an employer effectively hire highly intrinsically motivated workers?

The insights of the paper can be used at the hiring decisions of the employer to determine which contract length and wage scheme are effective to select motivated workers. This study is socially relevant because effectively hiring strategies focused on motivated workers has the potential to boost the organization's performance. We examine different contract lengths and wage schemes due to their varying characteristics that impact hiring strategies. Short-term contracts offer flexibility and can adapt to evolving information over time unlike long-term contracts. Incentive wage schemes, as opposed to fixed wage schemes, provide a higher incentive for hiring workers, allowing them to try-out the job. These characteristics can be crucial for an employer to effectively hire highly motivated workers.

The paper is structured as follow: Chapter 2 delves into related literature, chapter 3 elaborates on the intertemporal choice model for multiple short-term contracts, chapter 4 discusses the long-term contract, chapter 5 presents the comparison of the different contract lengths and wage schemes, chapter 6 addresses the limitations of the study and chapter 7 provides a conclusion. Additionally, the appendix will contain mathematical explanations that support the model.

2. Literature Review

In this chapter, we will delve into the related literature behind our paper. We aim to make a contribution to the field of research with this study. The relevant literature will discuss information in the hiring process, intrinsic motivation as an experience good and how to differentiate between worker types using wages or exit bonuses.

The complexity of the employer's hiring process is affected by asymmetric information, where one party possesses more information than the other regarding their interests in the organization (Akerlof, 1970). Both employer and worker aim to maximize their utility in this employment transaction. Nonetheless, the uncertainty from asymmetric information can result in fewer mutually beneficial employment transactions. The employer is more informed about the job characteristics of the job. Conversely, the worker has private knowledge about their motivation and cost of working. Credibly communicating their own information to the other party, can be difficult.

As mentioned earlier, in our model intrinsic motivation is seen as an experience good. Shapiro (1983) argues that many new products have unknown features for the consumer. Intrinsic motivation is bundled at the job because of the specific job characteristics such as the content of the task or work environment are important for the motivation of the worker. In this paper we assume that a worker has to experience the job for a period of time to learn his intrinsic motivation at that specific job position. Determining the exact value of the job before working at the job is therefore difficult. The decision to accept the offer of the employer will therefore depend on expected value of the worker. Initial misperceptions about the value of the job position can lead in the short run to affect the welfare both positively and negatively. However the expectation needs to adjust, so that in the long run the welfare is not affected. Therefore, we anticipate that an employer's expectations of worker motivation during the hiring process will, over time, align with the actual proportion of motivated workers in real life.

A way to credibly communicate about workers motivation is by setting a minimum wage in a vacancy that can work as a screenings mechanism (Delfgaauw & Dur, 2007). Under both a fixed wage scheme and an incentive wage scheme, the employer is able to screen for motivated workers. Accepting a low wage can work as a signal for highly motivated workers. In their model, determining the optimal wage to hire a worker depends on a trade-off: offering a higher wage may boost the likelihood of filling a vacancy, but it could simultaneously reduce the expected level of motivation from the worker. The

worker in the model only varies in their intrinsic motivation not in their cost of effort and outside option. This assumption is also used in our model, where the only variation of workers comes from a difference in intrinsic motivation.

Workers vary not only in motivation but also in ability. Delfgaauw and Dur (2008) examine which workers are the most efficient to hire for an employer in the public sector according to motivation and ability. The principal-agent model of this paper is used as basis in our study. The paper assumes three types of workers dedicated, lazy and regular. These types of workers vary in motivation and ability. Higher wages will lead to workers with a higher ability, reflected as lower cost of working in our model. If we assume that effort is unverifiable, the study indicates that lazy workers may crowd out dedicated workers in the public sector. The underlying reason is that a worker can accept a lower wage, because of higher motivation or lower ability. Consequently, the employer has difficulties with the separation between dedicated workers and lazy workers by setting a lower wage. Assuming that effort of the worker is verifiable, it can sometimes be valuable to hire lazy workers besides dedicated workers. The employer is now able to offer separating contracts using different wage schemes. The contract will be distorted, but optimal for producing public goods while minimizing the costs.

Furthermore, in both studies intrinsic motivation is defined as the joy of exerting effort at the job of the employer. This definition is the one we also keep in the model of our paper. A key distinction between our study and the other two studies is the assumption regarding intrinsic motivation. Initially in our study, motivation is unknown to both parties; it only becomes private information to the worker after they have been employed for a while. As in the other studies, intrinsic motivation was known by the worker even before working at the job.

A study that also considers intrinsic motivation of a worker as an experience good is that of Dur and Schmittdiel (2019). They set up a principal-agent model with N+1 periods, similar to our study. In their model, workers can differ in commitment, motivation and outside option opportunities, whereas in our study, they only differ in motivation. The commitment of a worker is considered as private information. The employer aims to screen for committed and motivated workers. They found that a steep wage-tenure profile can attract committed workers, but such wage profile does not separate between different levels of workers' motivation. To address the adverse selection of both committed and motivated workers, the employer could implement an exit bonus. For the exit bonus to be effective in ensuring that unmotivated workers quit voluntarily, it must come as a surprise. In our model, a worker can choose to continue or end the employment relationship with the employer under a short-term

contract voluntarily without the possibility of receiving an exit bonus. During a long-term contract, voluntary quitting by the worker or firing by the employer is not permitted.

Dal Bó, et al. (2013) assumed that productivity and motivation is not independent of each other. They argue that workers who are more productive often also have more motivation. Setting a wage can be challenging: a high wage will attract workers with a high ability, but a low wage will attract highly motivated workers. Hence attracting productive and motivated workers is more challenging in practise. They examine a natural experiment where different salaries were randomly announced across recruitment sited in the public sector of Mexico. Their results were that a higher wage attract more productive and motivated job applicants measured by IQ and personality traits of motivation towards the public service, the PSM index. They could not confirm by empirical evidence the adverse selection on motivation. In our paper, we do not focus on the heterogeneity of ability among workers. Our model assumes that all workers have the same cost of exerting effort and the same outside option. By not considering the potential correlation between productivity and motivation, this limitation may lead to difference between real-life outcomes and the predictions of our model. Another finding of their empirical study was that the public sector of Mexico had some degree of monopsony power. As discussed in the other theoretical papers, monopsony power by the employer is assumed. This will be also an assumption in our study.

Furthermore, the theoretical model of the next chapter will consist of a principal-agent model with multiple periods, the intertemporal choice model (Frank and Cartwright, 2016). It is a decision-making model considering the effect of the choices for the present and future. In the model the employer and worker will maximize their utility under the restrictions of the decisions of the other individual. Analysing the model gives an opportunity to get insights about the decision-making conditions to hire a worker under different contract lengths and wage schemes. This can be used by employers to develop an optimal approach for contracts by hiring decisions to reach their objectives.

3. Intertemporal choice model

This chapter will delve into the intertemporal choice model. This model will explain the decisions of the employer (principal) and the worker (agent) on hiring. In this principal-agent model, the players take their decisions sequentially. First a simple model with one period will be set up. The insights of this first model will be implemented in an intertemporal choice model with two periods and a model with an unspecified number of periods. The goal of this model is to gain a better understanding of the employer's decision regarding hiring a worker. An important feature of this intertemporal choice model is the assumption that the worker can learn his intrinsic motivation by one period of working at the employer. Within this chapter, we assume that the employer can only offer multiple short-term contracts, which are binding for one period.

For each model, we will examine two different wage schemes. The first scheme features a fixed wage, independent of the effort level. The second scheme includes an incentive-based wage, where the employer offers both a fixed wage and a bonus payment tied to the effort level.

3.1 The one-period model

The model consists of a worker deciding to accept the offer of the employer. The employer in the model decides if he wants to hire the worker. In this model we assume that all individuals are risk neutral and rational. The worker and the employer are assumed to maximize their own utility. The utility function of a worker working at the employer is:

$$U_{Ai} = w + \gamma_i V(e) - C(e) \quad (1)$$

There are two types of motivated workers in this model (γ_i): a worker with a high intrinsic motivation (γ_H) is called a high type worker and an worker with low intrinsic motivation (γ_L) is called a low type worker. The worker type is notated as i , where $i \in \{H, L\}$. We assume that:

$$\gamma_H > \gamma_L \geq 0 \quad (2)$$

In this model, effort can never contain a negative value ($e \geq 0$). Intrinsic motivation in this model is defined as a benefit from doing effort. Furthermore, the model assumes that this intrinsic motivation is specific for the job performed by the worker at the employer. Therefore, the outside option (U_{out}) of the worker does not differ between the types. The outside option can be working for another

employer or receiving benefits from the state. The function of the benefits of effort, $V(e)$, is concave. The associated properties of the functions are $V(0) = 0$, $V'(e) > 0$ and $V''(e) < 0$. The cost of working at the employer is for simplicity the same for both types in this model. The function of the costs of effort, $C(e)$, is convex with properties $C(0) = 0$, $C'(e) > 0$ and $C''(e) > 0$. Those costs contain all negative consequences of effort. Another assumption is that the only cost of the employer is the wage of the worker (w). The level of revenue will depend on the worker's effort and the price. We assume that $p > 0$, because the effort will result in production of output that can be sold at a price, thereby generating revenue for the employer. The utility function of the employer is:

$$U_P = pe - w \quad (3)$$

We assume that the utility of the employer when he does not hire a worker is equal to zero. In the first period of every model in this paper, we assume that that both players do not know the type of the worker. The worker will base his decision to accept the contract on the expected value of the intrinsic motivation. The expected intrinsic motivation is based on the chance of being a high type worker (π) or a low type worker $(1 - \pi)$. We assume that $0 \leq \pi \leq 1$. That means that the condition of the expected intrinsic motivation is:

$$\gamma_E = \pi\gamma_H + (1 - \pi)\gamma_L \quad (4)$$

The employer will take the decision of the worker accepting the contract and associated effort level into account when deciding to offer a contract to the worker. The timeline of a period in the model of this chapter under a short-term contract, is as followed:

1. The employer offers the worker a contract with a wage scheme.
2. The worker accepts or reject the offer of the employer.
3. If the worker accepts the offer than he will choose his level of effort. By rejecting the offer, the worker will receive the outside option.

The employer only offers a fixed wage

In this model a fixed wage is defined as a wage that is independent of the amount of effort. Reasons for the employer to only pay a fixed wage could be that a performance measurement that can verify the worker's effort is too expensive or impossible to implement. The wage scheme will look like:

$$w = \alpha \quad (5)$$

Solving the model, backward induction is used. The worker decides the level of effort by maximizing his expected utility. Both types will choose the same level of effort because they have not learned their type yet. The level of effort is determined by the first order condition of the worker's expected utility equal to zero:

$$\frac{\partial EU_{AE}}{\partial e^E} = \gamma_E V'(e^E) - C'(e^E) = 0 \quad (6)$$

To decide when an employer will hire a worker, he will take into account when a worker accepts his offer. The expected utility of working at the employer needs to be higher than the outside option. The minimum wage set by the employer needs to be:

$$\alpha_{AE}^{min} = U_{out} - \gamma_E V(e^E) + C(e^E) \quad (7)$$

The employer will offer a contract to the worker if the following condition holds:

$$EU_P = pe^E - U_{out} + \gamma_E V(e^E) - C(e^E) \geq 0 \quad (8)$$

The employer offers an incentive wage scheme

To set up an incentive wage scheme that will increase the employer's utility, the employer needs a performance measurement that is representative of worker's effort. In this model an incentive wage scheme consists of a bonus payment for each level of effort. We assume that the employer of this model has a perfect performance measurement available and is therefore able to pay a bonus based on the effort level. The incentive wage scheme is linear:

$$w = \alpha + \beta e \quad (9)$$

Due the bonus payment the employer will influence the workers' decisions of the level of effort. Assuming that the worker will maximize his utility, the worker will choose the level of effort based on the following condition:

$$\frac{\partial EU_{AiB}}{\partial e^{iB}} = \beta + \gamma_i V'\left(e^{iB}\right) - C'\left(e^{iB}\right) = 0 \quad (10)$$

The employer determines the bonus payment by maximizing his utility. The optimal level of the worker's effort for the employer is determined by the first order condition of the employer's expected utility that is equal to zero:

$$\frac{\partial EU_{PiB}}{\partial e^{iB}} = p + \gamma_i V'\left(e^{iB}\right) - C'\left(e^{iB}\right) = 0 \qquad (11)$$

The employer determines the level of bonus payment to align the worker's optimal effort level with his own optimal effort level. The price is given in this model and determines the level of effort that is optimal for the employer. To align that optimal level of effort of the employer with the worker, the following conditions must hold:

$$p = -\gamma_i V'\left(e^{iB}\right) + C'\left(e^{iB}\right) \wedge \beta = -\gamma_i V'\left(e^{iB}\right) + C'\left(e^{iB}\right) \qquad (12)$$

Thus, independent of the worker's type the employer will always set the bonus payment equal to the price if he offers a contract to the worker:

$$\beta = p \qquad (13)$$

The next step is to determine the level of effort when the worker does not know his motivation. The worker has not learned his type in period one and will base his decision on the expected intrinsic motivation. Both types of workers will choose the same level of effort determined by the following first order condition based on their expected utility:

$$\frac{\partial EU_{AEB}}{\partial e^{EB}} = p + \gamma_E V'(e^{EB}) - C'(e^{EB}) = 0 \qquad (14)$$

The worker's effort when the employer pays a bonus payment is higher compared to the scenario when there is only a fixed wage. This corresponds with aim of the bonus payment to increase the importance of effort for the worker. The worker's effort level is now fully aligned with the employer's effort level.

$$e^{EB} > e^{E} \qquad (15)$$

Now that the bonus payment and the worker's effort level are determined, we can identify the condition for the minimum wage for which the worker accepts the contract. The offer of the employer needs to be more attractive than the outside option for the worker. The minimum fixed wage needs to be:

$$\alpha_{AEB}^{min} = U_{out} - \gamma_E V(e^{EB}) + C(e^{EB}) - pe^{EB} \quad (16)$$

The condition of the employer willing to offer a contract to the worker when there is a bonus payment is:

$$EU_{PB} = pe^{EB} - U_{out} + \gamma_E V(e^{EB}) - C(e^{EB}) \geq 0 \quad (17)$$

3.2 The two-period model

In the intertemporal choice model of this paper, the worker and the employer do not discount for future transactions. For simplicity, we assume that worker and employer value today the same as in future. The employer in this model with two periods offers two short-term contracts. This means that for each period the employer will offer a new contract and therefore the wage can differ between the two periods. The worker can decide each period to accept or reject the contract.

The employer only offers a fixed wage

Using backward induction, we first examine the decisions made in period two, so we can incorporate them into our analysis of period one. In the periods after period one the worker has learnt his type. High type workers will therefore make other decisions than low type workers. To determine the optimal amount of effort of a worker with type *i*, the following first order condition must hold:

$$\frac{\partial U_{Ai}}{\partial e^i} = \gamma_i V'(e^i) - C'(e^i) = 0 \quad (18)$$

The high type worker has a higher intrinsic motivation than the low type worker. According to condition 18, the level of effort depends on the intrinsic motivation of the worker. The high type worker yields more utility from exerting effort. As a result, the high type worker will exert more effort than the low type worker in this model. This is also proven at appendix A.

$$e^H > e^E > e^L \quad (19)$$

Furthermore, in this model, we assume that only high type workers are attractive to hire for the employer:

$$U_{PH} = pe^H - \alpha_{AH}^{min} > 0 \ \wedge \ U_{PL} = pe^L - \alpha_{AL}^{min} < 0 \quad (20)$$

Therefore, the employer wants to hire only high types workers if he is able to separate between the different motivation types of workers. A high type worker will accept the contract under different conditions than low type worker. To create separating contracts that will attract the intended type of worker, the employer needs to understand the differences between the types of workers in accepting the contract. The minimum fixed wage for a worker with type *i* to accept the contract of the employer is:

$$\alpha_{Ai}^{min} = U_{out} - \gamma_i V(e^i) + C(e^i) \quad (21)$$

The worker will accept the contract if working at the employer yields the same utility as the outside option. According to condition 21, keeping the effort constant, a higher motivation led to an increase in utility of the worker. However, effort is not constant if intrinsic motivation increases. If a worker has higher intrinsic motivation than he will exert more effort as shown in condition 18. The increase in effort results in both benefits and costs. We assume that the total benefits of a higher intrinsic motivation are larger than the costs. Therefore, the following condition must hold:

$$\beta E'(\gamma_i) + \gamma_i V'\big(E(\gamma_i)\big)E'(\gamma_i) + V\big(E(\gamma_i)\big) > C'\big(E(\gamma_i)\big)E'(\gamma_i) \quad (22)$$

Using the implicit function theorem, the proof of condition 22 can be found in the appendix B. A higher intrinsic motivation of the worker will decrease the minimum wage level of accepting the contract. The underlying reason is the assumption that there will be an increase in total utility due to intrinsic motivation. The utility gain derived from intrinsic motivation explains why the worker has to be less compensated by wage to accept the offer of the employer. Thus, low type workers have a higher minimum fixed wage than high type workers:

$$\alpha_{AL}^{min} > \alpha_{AE}^{min} > \alpha_{AH}^{min} \quad (23)$$

The employer can attract only high type workers by offering the minimum wage level of high type workers (α_{AH}^{min}) if the worker has learnt his type. Information about the intrinsic motivation at the job is unknown in period one for everyone. Therefore, it is not possible for the employer in period one to separate between the different types. The worker will decide to accept the offer of the employer in the first period by maximizing his expected utility for the two periods:

$$EU_{2A} = EU_{AE}(e^E) + \pi U_{AH} + [1 - \pi]U_{out} \quad (24)$$

We assume that the employer has monopsony power. Monopsony power arises from specific job characteristics that are only available when working at the employer. Due the monopsony power the employer will extract all the rents of the worker. The employer will offer the minimum fixed wage and the worker will accept that offer. We know the following information about the utility and minimum fixed wage of the high type worker when he knows his type.

$$U_{AH} = \alpha_{AH}^{min} + \gamma_H V(e^H) - C(e^H) \ \wedge \ \alpha_{AH}^{min} = U_{out} - \gamma_H V(e^H) + C(e^H) \quad (25)$$

Substituting the minimum fixed wage into the utility function gives:

$$U_{AH} = U_{out} \quad (26)$$

Therefore, the utility of outside option of the worker will always be equal to the utility of working at the employer. Rewriting the expected utility of the worker over the two periods is:

$$EU_{2A} = EU_{AE}(e^E) + NU_{out} \quad (27)$$

The employer wants to know the worker's level of effort in the first period to determine which wage he needs to offer. The worker will decide the level of effort for a period based on maximizing his expected utility. However, the level of effort in period one does not influence the utility in other periods than period one. Every period the worker can decide the level of effort again. The worker makes his decisions based on the information in period one. In all the models of this paper, that information is the same, because the worker's type in period one is always unknown. Therefore, the worker will base his level of effort in period one only on the expected utility of period one. This implies that:

$$\frac{\partial EU_{2A}}{\partial e^E} = \frac{\partial EU_{AE}}{\partial e^E} \quad (28)$$

Therefore, the level of effort in the first period is always the same as in the one-period model under the same wage scheme. Assuming that the employer can offer a new short-term contract each period, the wage is allowed to vary across periods. Condition 26 showed that in period two, working at the employer yields the same utility as the outside option, because of the monopsony power. Therefore, the minimum fixed wage that the worker is willing to accept in period one is determined solely by the

expected utility of the first period. The participation condition of the two-period model contains the same minimum wage as in the one-period model:

$$\alpha_{AE}^{min} + \gamma_E V(e^E) - C(e^E) + U_{out} = 2U_{out} \quad (29)$$

Consequently, condition 7 specifies the minimum fixed wage the worker will accept in period one. The employer decides to offer a contract to the worker based on his expected utility of the two periods. Therefore, losses in period one can be compensated by gains in the second period. As long as the overall expected utility is positive for the employer, then he will hire a worker in period one. The employer will offer a contract to a worker in period one if the following condition holds:

$$\begin{aligned} EU_{2P} &= EU_P(e^E) + \pi U_{PH} \\ &= pe^E - U_{out} + \gamma_E V(e^E) - C(e^E) + \pi U_{PH} \geq 0 \end{aligned} \quad (30)$$

The employer offers an incentive wage scheme

When the employer also offers a bonus payment besides a fixed wage, the workers decisions will be influenced by that bonus payment. As shown in condition 13, independent of workers type the employer will set the bonus payment equal to the price to maximize his utility. In the second period, the worker knows his type of motivation and will base his effort decision on that information. The level of effort in period two for a worker with type *i*, is determined by setting the first order condition equal to zero:

$$\frac{\partial U_{AiB}}{\partial e^{iB}} = p + \gamma_i V'(e^{iB}) - C'(e^{iB}) = 0 \quad (31)$$

The bonus payment and cost of effort is the same for each worker type. The high type workers only vary in the intrinsic motivation compared to the low type workers. The consequences of this variation will lead to differences in exerting effort. Higher intrinsic motivation leads to more benefits of exerting effort and thus higher utility. As demonstrated in appendix A, high type workers will exert more effort than low type workers:

$$e^{HB} > e^{EB} > e^{LB} \quad (32)$$

A worker of type *i*, will accept the contract if the following condition holds for minimum fixed wage:

$$\alpha_{AiB}^{min} = U_{out} - \gamma_i V\left(e^{iB}\right) + C(e^{iB}) \; - \; pe^{iB} \qquad (33)$$

Furthermore, we assume that only high type workers are attractive to the employer. We assume that the following conditions will hold:

$$U_{PHB} = -\alpha_{AHB}^{min} > 0 \; \wedge \; U_{PLB} = -\alpha_{ALB}^{min} < 0 \qquad (34)$$

Therefore, the employer prefers to separate the low types from the high types workers. This is possible for the employer due setting a lower fixed wage by the employer. As is shown in appendix B, high type workers accept a lower minimum fixed wage compared to low types. The following condition will hold:

$$\alpha_{AHB}^{min} < \alpha_{AEB}^{min} < \alpha_{ALB}^{min} \qquad (35)$$

Noteworthy to mentioned is that the fixed wage that the employer is going to offer to the high type worker is negative in this model. This means that if the worker does not exert effort than the worker needs to pay the employer an amount. The underlying reason is that the worker decides to exert enough effort to maximize his utility. As a result of the effort the high type worker will receive a wage due the bonus payment. Even if the negative fixed wage is abstracted from the wage of the bonus payment, then the contract of the employer is still more attractive than the outside option. In period one, the type of the worker is still unknown, the worker will decide to accept the offer based on the expected utility of the two periods. The expected utility of both periods is:

$$EU_{2AB} = EU_{AEB}(e^{EB}) + \pi U_{AHB} + [1 - \pi]U_{out} \qquad (36)$$

The monopsony power of the employer will extract all the rents of the worker and therefore a high type worker will be indifferent between the outside option and working at the employer as shown in condition 26. Under the assumption of short-term contracts, the level of effort in period one will only depend on the expected utility of the first period. In period one the motivation is always unknown; the level of effort is based on this information. This implies that:

$$\frac{\partial EU_{2AB}}{\partial e^{EB}} = \frac{\partial EU_{AEB}}{\partial e^{EB}} \qquad (37)$$

The minimum fixed wage level will be the same as condition 7. This is the result of the participation condition of a two-period model that holds:

$$\alpha_{AEB}^{min} + \gamma_E V(e^{EB}) - C(e^{EB}) + U_{out} = 2U_{out} \quad (38)$$

The condition of the employer to hire a worker in period one when offering an incentive wage scheme, is:

$$\begin{aligned} EU_{2PB} &= EU_{PB}(e^{EB}) + \pi U_{PHB} \\ &= pe^{EB} - U_{out} + \gamma_E V(e^{EB}) - C(e^{EB}) + \pi U_{PHB} \geq 0 \end{aligned} \quad (39)$$

3.3 Multiple short-term contracts

The obtained information at the previous models is used to look at a model with an unspecified number of periods defined as N+1. We assume that each period the employer and the worker negotiate again, so only multiple short-term contracts will be offered in this section. From the model with one period, the decisions about the level of effort and minimum fixed wage in period one is used. As we saw in conditions 28, 29, 37 and 38 adding more periods does not influence the level of effort and the minimum fixed wage in period one when the employer offers short-term contracts. The two-period model determines the decisions of a worker who has learnt his type of motivation. In all the periods after the first period, the interaction of the employer and the worker will remain the same. After the worker has learnt his type in this model, there is no new information revealed.

Employer offers only a fixed wage

The expected utility in period one of a N+1 periods model when the employer offers only a fixed wage for the worker is:

$$EU_{NA} = EU_{AE}(e^{E}) + \pi N U_{AH} + [1 - \pi] N U_{out} \quad (40)$$

We fill in the obtained information of the other models. The condition of the employer to hire a worker in period 1 in an N+1 period model with only a fixed wage is:

$$\begin{aligned} EU_{NP} &= pe^{E} - \alpha_{AE}^{min} + \pi N\left[pe^{H} - \alpha_{AH}^{min}\right] \\ &= pe^{E} - U_{out} + \gamma_E V(e^{E}) - C(e^{E}) + \pi N U_{PH} \geq 0 \end{aligned} \quad (41)$$

Employer offers an incentive wage scheme

When the bonus payment is applicable for the employer, the bonus will always be equal to the price as showed in condition 13. The expected utility of a worker in period one in a model with N+1 periods when the employer use a bonus payment is:

$$EU_{NAB} = EU_{AEB}(e^{EB}) + \pi NU_{AHB} + [1-\pi]NU_{out} \quad (42)$$

Both types are indifferent of working at the employer and the outside option in period one. In the periods after period one, low type workers will always choose the outside option. High type workers are still indifferent. The condition to hire a worker in the first period for the employer is of a N+1 periods model with an incentive wage scheme:

$$\begin{aligned} EU_{NPB} &= -\alpha_{AEB}^{min} + N\pi\left[-\alpha_{AHB}^{min}\right] \\ &= pe^{EB} - U_{out} + \gamma_E V(e^{EB}) - C(e^{EB}) + \pi NU_{PHB} \geq 0 \end{aligned} \quad (43)$$

4. A long-term contract

In the previous chapter, the employer offered the worker each period a new contract that the worker could accept or reject. Those short-term contracts are only binding for one period. This allows the employer to offer different wage schemes among the periods. The results from the intertemporal choice model under short-term contracts, shows that the employer will offer a different wage in period one compared to the other periods. In the periods after the first period the worker has learnt his type of intrinsic motivation, and the employer can use this information by offering a different wage. After period two, there is no new information added in the model and therefore the decisions are made under the same circumstances. In this model, a long-term contract is defined as a contract that includes a timeframe of more than one period. When the employer offers a long-term contract in period one, the wage negotiated in period one is binding for all periods of the long-term employment relation. Both contracts are assumed to be offered under the same economic circumstances including the assumption that the multiple short-term contracts cover the same length of a long-term contract. The intertemporal choice model is already set up. In this chapter we are looking at the model with an unspecified number of periods under a long-term contract. This extension is analysed for the two different wage schemes.

The employer only offers a fixed wage

The employer will offer a long-term contract in period one. The contract is binding for N+1 period and each period has the same fixed wage. The expected utility over N+1 periods of the worker working at the employer is given by:

$$EU_{NA}^{Long} = \alpha^{Long} + \gamma_E V(e^E) - C(e^E) + N\pi[\alpha^{Long} + \gamma_H V(e^H) - C(e^H)] + N[1-\pi][\alpha^{Long} + \gamma_L V(e^L) - C(e^L)] \quad (44)$$

The effort level of the worker in each period is the same as under the short-term contracts, shown by condition 18. The worker decides to accept the offer of the employer by comparing the expected utility of working N+1 periods at the employer with doing the outside option for N+1 periods. Accepting the contract must be more attractive than rejecting the contract, because of a higher expected utility. The minimum fixed wage that the worker is willing to accept is given by the following condition:

$$\alpha_{Long}^{min} = \frac{[1+N]U_{out} - \gamma_E V(e^E) + C(e^E) - N\pi[\gamma_H V(e^H) - C(e^H)] - N[1-\pi][\gamma_L V(e^L) - C(e^L)]}{[1+N]} \quad (45)$$

Rewriting the minimum fixed wage at a long-term contract as a weighted wage of other minimum wages:

$$\alpha_{Long}^{min} = \frac{\alpha_{AE}^{min} + N\pi[\alpha_{AH}^{min}] + N[1-\pi][\alpha_{AL}^{min}]}{[1+N]} \quad (46)$$

The weighted wage of condition 46 in addition to condition 23 implies that:

$$\alpha_{AH}^{min} < \alpha_{Long}^{min} \quad (47)$$

This shows that if the employer has hired a high type worker in the periods after period one, the employer's profit of those periods is always smaller under a long-term contract compared to short-term contract. The revenue of a high type worker in the periods after period one will remain the same, but the wage cost for the employer is higher. The higher wage cost is a consequence of being able to attract a worker in period one that has not learned his type yet. The employer is not able to separate between high and low type workers, because the contract is offered in period one when motivation is unknown for both parties. Therefore, the type of the worker cannot be reflected in a long-term contract. We assume that the employer has a negative utility, if he hired a low type worker and the worker knows his type. A high type worker will lead to a positive utility for the employer. This leads to the following assumptions:

$$U_{PH}^{Long} = pe^{H} - \alpha_{Long}^{min} > 0 \ \wedge \ U_{PL}^{Long} = pe^{L} - \alpha_{Long}^{min} < 0 \quad (48)$$

The condition of the employer to hire a worker in period one offering a long-term contract with only a fixed wage is:

$$EU_{NP}^{Long} = pe^{E} - \alpha_{Long}^{min} + \pi N\left[pe^{H} - \alpha_{Long}^{min}\right] + [1-\pi]N\left[pe^{L} - \alpha_{Long}^{min}\right] \geq 0 \quad (49)$$

The employer cannot lay off the worker during the long-term contract. Although the expected utility of hiring a worker is positive, the actual utility in the periods after the first period can be negative if a low type worker is hired. Employing a worker carries risk to the employer's utility.

The employer offers an incentive wage

The employer will offer a wage scheme that has the same fixed wage and bonus payment in all periods of the N+1 model. In this model, the employer will always implement a bonus payment equal to the

price as showed in condition 13 of the previous chapter. The level of effort is the same as under a short-term contract with incentive wage scheme, shown in condition 31. The worker determines the minimum fixed wage for accepting the offer by comparing the expected utility of working at the employer with the utility of the outside option for N+1 periods.

$$EU_{NAB}^{Long} = \alpha^{LongB} + \beta e + \gamma_E V(e^{EB}) - C(e^{EB}) + N\pi[\alpha^{LongB} + \beta e^H + \gamma_H V(e^{HB}) - C(e^{HB})] + N[1-\pi][\alpha^{LongB} + \beta e^L + \gamma_L V(e^{LB}) - C(e^{LB})] > [1+N]U_{out} \quad (50)$$

The minimum fixed wage the worker is willing to accept in the contract of the employer is:

$$\alpha_{LongB}^{min} = \frac{[1+N]U_{out} - [pe + \gamma_E V(e^{EB}) - C(e^{EB})] - N\pi[pe^{HB} + \gamma_H V(e^{HB}) - C(e^{HB})] - N[1-\pi][pe^{LB} + \gamma_L V(e^{LB}) - C(e^L)]}{[1+N]} \quad (51)$$

Rewriting the minimum wage as the weighted average of minimum wages results in:

$$\alpha_{LongB}^{min} = \frac{\alpha_{AEB}^{min} + N\pi[\alpha_{AHB}^{min}] + N[1-\pi][\alpha_{ALB}^{min}]}{[1+N]} \quad (52)$$

By combining condition 35 with the weighted wage outlined in condition 52, we can demonstrate that:

$$\alpha_{AHB}^{min} < \alpha_{LongB}^{min} \quad (53)$$

We have seen that under a long-term contract, it is not possible for the employer to separate between different types of workers. When the employer offers a wage including a bonus payment, the utility of the employer is given by the following condition:

$$U_{PBH}^{Long} = U_{PBL}^{Long} = -\alpha_{LongB}^{min} \quad (54)$$

The net utility of the employer depends solely on the fixed wage negotiated in period one. A highly motivated worker will exert more effort and generate more revenue. However, this will be cancelled out by the bonus payment that the employer needs to pay out. As a result, the employer has no preference for a particular type of worker, leading to a certain utility based entirely on the fixed wage specified in the contract, independent of the worker's type. In contrast, the worker's utility remains uncertain in period one since the worker does not yet know if they are a high or low type worker. A

high type worker will exert more effort and thus receive a higher wage due to the bonus payment compared to a low type worker. Consequently, the employer is unable to exploit the value of a high intrinsic motivation of a worker under a long-term contract. The minimum fixed wage that a worker accepts in period one needs to be negative, otherwise the employer will not hire this worker. The condition of the employer to hire a worker in period one offering a long-term contract with bonus payment:

$$U_{NPB}^{Long} = -[1 + N]\alpha_{LongB}^{min} \geq 0 \qquad (55)$$

5. Comparing different contract lengths and wage schemes

In this chapter, four different cases of contracts are compared. First, we determine the effect of a potential long employment relation under a short-term contract. Furthermore we focus on the comparison of multiple short-term contracts with a long-term contract under two different wage schemes: only fixed wage and a fixed wage with a bonus payment.

We are looking at four cases of contracts because we expect them to impact employer's hiring decision due to their unique characteristics. Short-term contracts, which can be adjusted at the end of each contract period, offer the flexibility to incorporate new information. This flexibility is beneficial because it allows employers to hire motivated workers more effectively, as these workers need time to learn their motivation. In contrast, a long-term contract is static and unable to adapt new information regarding workers' motivation. Additionally, each wage scheme has its own distinct properties. Fixed wage schemes provide equal compensation to all workers, regardless of their effort. Incentive wage schemes reward workers based on their performance, with bonus payments aligning the interest of both the employer and the worker. This alignment increases the employer's incentive to hire, giving more workers the opportunity to learn their motivation. By comparing short-term and long-term contracts alongside fixed and incentive wage schemes, we aim to identify the optimal combination of contract length and wage scheme for effectively hiring motivated workers.

5.1 Single short-term contract compared to multiple short-term contracts

The conditions 8, 30 and 41 about the decision of the employer to hire a worker in the first period, imply:

$$EU_{NP} > EU_{2P} > EU_{P} \tag{56}$$

After working one period, the worker has learned his type of intrinsic motivation. The employer in this model can use the information of the workers. By setting a wage that only attracts high intrinsic motivated workers, the employer can separate between the two types of workers. We assumed that those future transactions are valuable for the employer because of the screening possibility for highly intrinsic motivated workers. The potential of more multiple short-term contracts will give higher incentives to the employer to hire a worker in period one. The underlying reason is that a negative utility of the employer in period one can be compensated by valuable future transactions when the employer is able to hire only high type workers. The same results hold for the situation where the employer offers a bonus payment. This is demonstrated by the conditions 17, 39, and 43:

$$EU_{NPB} > EU_{2PB} > EU_{PB} \quad (57)$$

5.2 Comparing multiple short-term contracts with a long-term contract

We want to determine for which contract length an employer is able to separate between high and low motivated workers and have a higher incentive to hire workers. We assume that the multiple short-term contracts in total have the same duration as a single long-term contract. First, we will look at the scenario where there is only a fixed wage offered by the employer. Therefore, we compare the conditions 41 and 49.

After period one, we have seen that an employer is able to separate the different types of workers under the short-term contract. We assumed that low type workers generate a loss for the employer. Therefore, the employer will only hire high type workers. Under a long-term contract, the contract details are fixed for a number of periods and the employer cannot fire a low type worker during the contract. The employer cannot separate between the different types of workers in the first period and is therefore not able to hire only motivated workers.

We assume that α_{AE}^{min} does not differ too much from α_{Fix}^{min}. We also expect a potential long employment relationship, so that N will be large. Therefore, the expected utility of the employer in period one become less relevant for the decision of the employer to hire a worker. According to condition 47, in the periods following period one, high type workers are less valuable under a long-term contract compared to multiple short-term contracts. Under a long-term contract low type workers will result in a loss for the employer. All these assumptions point to the following condition:

$$EU_{NP}^{Long} < EU_{NP} \quad (58)$$

This is proven in appendix C. This result shows that the employer has a higher incentive to hire a worker in period one under a short-term contract compared to a long-term contract, given the same circumstances.

For the comparison between a long-term contract and multiple short-term contracts under an incentive wage scheme, we look at the conditions 43 and 55. According to appendix D, if we assume that α_{AEB}^{min} is close to α_{LongB}^{min} and *N* is large. The following condition will hold:

$$U_{NPB}^{Long} < EU_{NPB} \quad (59)$$

Thus, the employer has a stronger incentive in period one to hire a worker under multiple short-term contracts rather than a long-term contract, regardless of the wage scheme. This approach allows more workers to learn their type, which is valuable for future employment transactions. It enables the employer to distinguish between workers based on their motivation types, thereby enhancing their ability to effectively hire highly motivated workers.

5.3 Comparison of wage schemes

When the employer offers a bonus payment, there is always a higher incentive to hire a worker in the first period compared the scenario with only a fixed wage. Under a short-term contract, according to the conditions 8, 17, 30, 39, 41, 43, the following conditions hold:

$$EU_{NPB} > EU_{NP} \ \wedge \ EU_{2PB} > EU_{2P} \ \wedge \ EU_{PB} > EU_{P} \quad (60)$$

Under a long-term contract, looking at condition 49 and 55, the following conditions must hold:

$$EU_{NPB}^{Long} > EU_{NP}^{Long} \quad (61)$$

There is a stronger incentive to hire a worker in the first period when there is an incentive wage scheme compared to wage schemes including only a fixed wage. The result will be that more workers will learn their type of motivation. Especially, under a short-term contract this can be valuable for future employment transactions to effectively hire highly motivated workers.

6. Discussion

This paper is focused on a theoretical model. Several assumptions are made that maybe in the real world will not always hold. Those assumptions pose concerns to apply the results straight on the hiring decision. The results need to be carefully interpreted. Dividing workers into a group of highly motivated workers and low motivated workers is a very simplified version of the reality. Some workers prefer some tasks more than other tasks of their job. Motivation can also depend on the personal situation of the worker and can therefore differ over time. The cost of exerting effort or the outside option can vary among workers. This variability can pose challenges in effectively screening for motivated workers. Our model does not account for this. Most individuals are not risk neutral or rational. This will create some frictions in the decision-making process between reality and the model.

Another limitation is that cutting off wage in a next working period does not have consequences on the decision-making process of the worker. In the model, we assume that the minimum wage can decrease in the next period without having consequences of feeling a loss. In real life, individuals feel losses stronger than gains, this is called loss aversion. Hence in reality, cutting off wages is not quit as simple as it seems. Another assumption in the model is about external incentives such as the bonus payment will not crowd out intrinsic motivation. In reality this assumption does not always hold. External incentives can lead to less motivation because of the social image that a worker will exert effort because of the monetary reward instead of the moral of the worker. Other social interactions of the wage influencing motivation for example by reputation are also excluded in this model.

It depends on the situation of the employer which contract the employer is able to offer to the worker. The legislation, available performance measurement of effort in an organization and other practical issues can hinder the employer to offer one of the examined contract lengths or wage schemes. Other advantages and disadvantages of the different contract lengths and wage schemes, apart from workers' motivation, must also be taken into account when offering contracts.

The reality is not perfectly reflected in all of the assumptions in the model. Relaxing some assumptions can maybe give a more realistic image of the hiring decision process. However, the results of the model give us some insight over under which contract lengths and wage schemes an employer is able to effectively hire a motivated worker.

7. Conclusion

The labour and skill shortages bring employers in a difficult position to find workers that they need for their organization. Effective hiring strategies are therefore crucial. Hiring engaged workers because of their high intrinsic motivation, can help the organization to succeed their objectives. A principal-agent model was set up to understand the interaction between the employer and different types of motivated worker in a hiring-decisions procedure under different contracts. We compare multiple short-term contracts with a long-term contract, each under two different wage schemes: only a fixed wage, and a fixed wage with a bonus payment. We have created a model were intrinsic motivated was an experience good. The worker needs to learn his motivation by working at the employer for a period. First, we looked into a model of one period, to get insights about hiring decision when motivation is unknown for both the employer and worker. By adding more periods, the worker had the possibility to learn his motivation. We saw that the potential for a longer employment relationship provides a stronger incentive to hire new workers.

The model's results indicate that under multiple short-term contracts, the worker learning his motivation is valuable for the employer. We have seen that under short-term contracts, the employer can effectively hire motivated workers after the try-out period by offering a lower minimum fixed wage. Furthermore, the results also showed that under short-term contracts compared to a long-term contract, the employer has a higher incentive to hire new workers. This allows more workers to learn their motivation and therefore the employer is able to select motivated workers more effectively. Only motivated workers will be rehired and result in a long-term employment relationship. Otherwise, the employment relationship ends after a single short-term contract.

In contrast, under a long-term contract, the worker's motivation cannot be reflected in the contract, as it is fixed from the first working period and cannot be adjusted. This applies to both wage schemes with only a fixed wage and those including a fixed wage with a bonus payment. Comparing different wage schemes under the same contract length, the model shows that an incentive wage scheme provides stronger incentives for employers to hire new workers. This leads to more workers learning their motivation. Only if short-term contracts are offered the employers are able to hire highly motivated workers more effectively.

Our model found another effect when comparing different contract lengths and wage schemes. Under all short-term contracts and a long-term contract with only a fixed wage, the employer was always

uncertain about the actual performance of the organization when he had the decision to hire a new worker. The actual performance was based on which type of motivated worker, the employer would actually hire. Those contracts carry a risk of a loss for the employer. Even with short-term contracts, there is a risk that a new worker may be a low type worker, resulting in a loss for the employer in the first period. The results showed that only with a long-term contract and an incentive wage scheme the worker's actual motivation does not matter, as the contract fixes their performance of the organization. This contract case provides some certainty for the employer, despite its inability to reflect the worker's motivation type, making it ineffective for hiring highly motivated workers.

In conclusion, an effective strategy to hire motivated workers is to offer a short-term contract to new workers with an optimal incentive wage scheme. However, an optimal wage scheme as a short-term contract is not always able to use. Other effects of the different contract lengths and wage schemes need to be considered during the hiring decision of the employer.

This study demonstrated that a short-term contract for workers could serve as a trial period to assess intrinsic motivation for the job. Only after this trial period under a short-term contract can the employer effectively screen for motivated workers by adjusting the wage. Our recommendation for future research is to conduct an empirical study to explore the impact of offering short-term contracts to new workers on hiring more motivated individuals within an organization. Additionally, it would be valuable to investigate theoretical models incorporating social interactions such as risk aversion, loss aversion or the positive correlation between worker motivation and ability. This approach could provide more realistic understanding of employers' hiring decisions.

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9. Appendices

Appendix A

Proof of condition 19 and condition 32:

The optimal level of effort is determined by the level of intrinsic motivation of the worker. This can be written as the following function:

$$\mathrm{e^i} = E(\gamma_\mathrm{i})$$

The worker will maximize his utility and therefore the first order condition of his utility function is set equal to zero. The function of optimal effort level is determined at condition 18.

$$\frac{\partial \mathrm{U_{Ai}}}{\partial \mathrm{e^i}} = \beta + \gamma_\mathrm{i} \mathrm{V'(e^i)} - \mathrm{C'(e^i)} = 0$$

Using the implicit function theorem to determine the relationship between the intrinsic motivation parameter and the level of effort.

$$[de^i][\beta + \gamma_i V"(e^i) - C"(e^i)] + [d\gamma_i][V'(e^i)] = 0$$

$$\frac{de^i}{d\gamma_i} = \frac{-V'(e^i)}{\beta + \gamma_i V"(e^i) - C"(e^i)}$$

The second order condition is always negative by maximizing the workers utility. Hence, we know that $\mathrm{V'(e^i)} > 0$ and $\beta + \gamma_\mathrm{i} \mathrm{V"(e^i)} - \mathrm{C"}\ (\mathrm{e^i}) < 0$. This means that:

$$E'(\gamma_\mathrm{i}) = \frac{\mathrm{de^i}}{\mathrm{d}\gamma_\mathrm{i}} > 0$$

In the scenario of only a fixed wage, there is no bonus payment ($\beta = 0$). This proof condition 19. In the scenario of an incentive wage scheme, the bonus payment will be equal to the price ($\beta = p$) as in condition 13. This proof condition 32.

Appendix B

Proof of condition 22 and 35 :

The level of effort depends on the intrinsic motivation of the worker. As proven in appendix A. This implies that an increase in intrinsic motivation lead to an increase in the effort level.
We assume that: $e^i = E(\gamma_i)$, with $E(0) = 0$ and $E'(\gamma_i) > 0$

Condition 33 shows the participation constraint of a worker and determine the minimum fixed wage of the worker when he is willing to accept the contract:

$$\alpha_{Ai}^{min} + \beta E(\gamma_i) + \gamma_i V\big(E(\gamma_i)\big) - C\big(E(\gamma_i)\big) - U_{out} = 0$$

Implicit function theorem to determine relationship $\alpha_{Ai}^{min}$and γ_i:

$$\big[d\alpha_{Ai}^{min}\big] + [d\gamma_i]\big[\beta E'(\gamma_i) + \gamma_i V'\big(E(\gamma_i)\big)E'(\gamma_i) + V\big(E(\gamma_i)\big) - C'\big(E(\gamma_i)\big)E'(\gamma_i)\big] = 0$$

$$\frac{d\alpha_{Ai}^{min}}{d\gamma_i} = -\beta E'(\gamma_i) - \gamma_i V'\big(E(\gamma_i)\big)E'(\gamma_i) - V\big(E(\gamma_i)\big) + C'\big(E(\gamma_i)\big)E'(\gamma_i)$$

We assume that:

$$\frac{d\alpha_{Ai}^{min}}{d\gamma_i} < 0$$

This implies that the following condition must hold:

$$\beta E'(\gamma_i) + \gamma_i V'\big(E(\gamma_i)\big)E'(\gamma_i) + V\big(E(\gamma_i)\big) > C'\big(E(\gamma_i)\big)E'(\gamma_i)$$

If the wage scheme only consists of a fixed wage, then the condition must holds for $\beta = 0$. When the wage scheme includes a bonus payment than the condition will hold while $\beta = p$.

Appendix C

Proof of condition 58:
We are comparing condition 41 with condition 49.

$$EU_{NP} = pe^E - \alpha_{AE}^{min} + \pi N\big[pe^H - \alpha_{AH}^{min}\big]$$

$$EU_{NP}^{Long} = pe^E - \alpha_{Long}^{min} + \pi N\big[pe^H - \alpha_{Long}^{min}\big] + [1-\pi]N\big[pe^L - \alpha_{Long}^{min}\big]$$

We need to make assumptions to compare the two conditions.

The first assumption is:

$$\alpha_{Long}^{min} \approx \alpha_{AE}^{min}$$

The second assumption is:

$$N \text{ is large}$$

We assume if *N* is large, so that the difference of $\left|\alpha_{Long}^{min} - \alpha_{AE}^{min}\right|$ is less important and therefore will be neglected for this comparison.

Therefore, we compare the following conditions with each other:

$$\pi N\left[pe^{H} - \alpha_{AH}^{min}\right] \wedge \pi N\left[pe^{H} - \alpha_{Long}^{min}\right] + [1-\pi]N\left[pe^{L} - \alpha_{Long}^{min}\right]$$

Condition 47 show that:

$$\alpha_{Long}^{min} > \alpha_{AH}^{min}$$

Condition 48 show that:

$$pe^{L} - \alpha_{Long}^{min} < 0$$

This will proof condition 58:

$$EU_{NP} > EU_{NP}^{Long}$$

Appendix D

Proof of condition 59:

We are comparing condition 43 with condition 55. First, we revise the conditions to simplify the comparison.

$$EU_{NPB} = -\alpha_{AEB}^{min} - N\pi\alpha_{AHB}^{min}$$

$$U_{NPB}^{Long} = -\alpha_{LongB}^{min} - N\alpha_{LongB}^{min}$$

We need to make a few assumptions to compare these two conditions.

The first assumption is:

$$\alpha_{LongB}^{min} \approx \alpha_{AEB}^{min}$$

The second assumption is:

$$N \text{ is large}$$

We assume if *N* is large enough, the difference of $\left|\alpha_{LongB}^{min} - \alpha_{AEB}^{min}\right|$ is less important and therefore will be neglected for this comparison.

Therefore, we compare the following conditions with each other:

$$-N\pi\alpha_{AHB}^{min} \wedge -N\alpha_{LongB}^{min}$$

Condition 53 show that:

$$\alpha_{LongB}^{min} > \alpha_{AHB}^{min}$$

This will proof condition 59:

$$EU_{NPB} > U_{NPB}^{Long}$$